USDA

United States Department of Agriculture

Natural Resources Conservation Service

Soil Science Division Update

4-18-2017 David Lindbo

Natural Resources Conservation Service

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Why Soils?

Do we need to know about them?

Consider this…

You are marooned

No vegetation present

You have water (of a sort)

You have a few merger tools etc.

You have some food but not enough until you can be rescued (hopefully)

You have seeds

What type of scientist
do you want to be?

A soil scientist
of course!

But why?

Soils are essential for food production

Proper soil fertility enhances plant growth

Healthy soils mean healthy food

Soil properties relate to several factors

Location of the best soils can be predicted

Know Soils, Know Life

Soils Affects Everyone

Agriculture
Forestry
Rangeland
Human Health
Soil Security
Urban
Art and Culture

Soil Science Division

Where do we fit in?

Congressional Mandate

- Inventory of the soil and vegetation resources (ecology)
- Make soil maps
- Analyze soil survey data
- Interpretative soil information
- Provide a form useful to a wide range of customers
- Keep soil survey relevant

Has this mandate changed?

Is it still relevant?

Why Now?

Demand has grown

- Water quality, quantity
- Urban agriculture
- Wetlands
- Climate change
- Watershed planning

Needs have changed

- Field to county to national in scope
- New customers
- Enhanced data
- Updates

SSD Strategic Plan

“By failing to prepare, you are preparing to fail.”
— Benjamin Franklin

“In preparing for battle I have always found that plans are useless, but planning is indispensable.”
— Dwight D. Eisenhower

Planning

“If you don't know where you are going, you'll end up someplace else.”
— Yogi Berra

“It does not do to leave a live dragon out of your calculations, if you live near him”
— J.R.R. Tolkien, The Hobbit

Soils2026

SSD Strategic Plan

VISION

A society that values soil as essential to life

MISSION

Provide scientifically-based soil and ecosystem information to manage natural resources

GOALS

INVENTORY – Produce soils- and ecosystem-information for conservation planning and resource management. (Inventory, database)

DELIVERY – Deliver soil- and ecosystem-based products for resource management. (Application, interpretation, analysis, delivery)

PEOPLE – Have an effective and engaged workforce.

PARTNERS – Strengthen and expand collaboration with all partners.

MARKETING – Develop and implement a marketing plan.

Expectations

Flexible and adaptable to changing needs

- Internal – NRCS priorities and goals
- External – NCSS and beyond

Authoritative information products

- All products **national in extent** (no gaps)
- Both properties and classes
- Useful

Expectations

Knowledge vs information

Using maps vs making maps

Services vs products

Relational vs singularity

Continuous vs completed

Projects vs acres

HOW?

Embrace a culture of continuous investigation and improvement

- Increase knowledge of soil science
- Increase use of technology and analytics
- Increase flexibility for a variety of customer and resource needs

An Iterative Approach

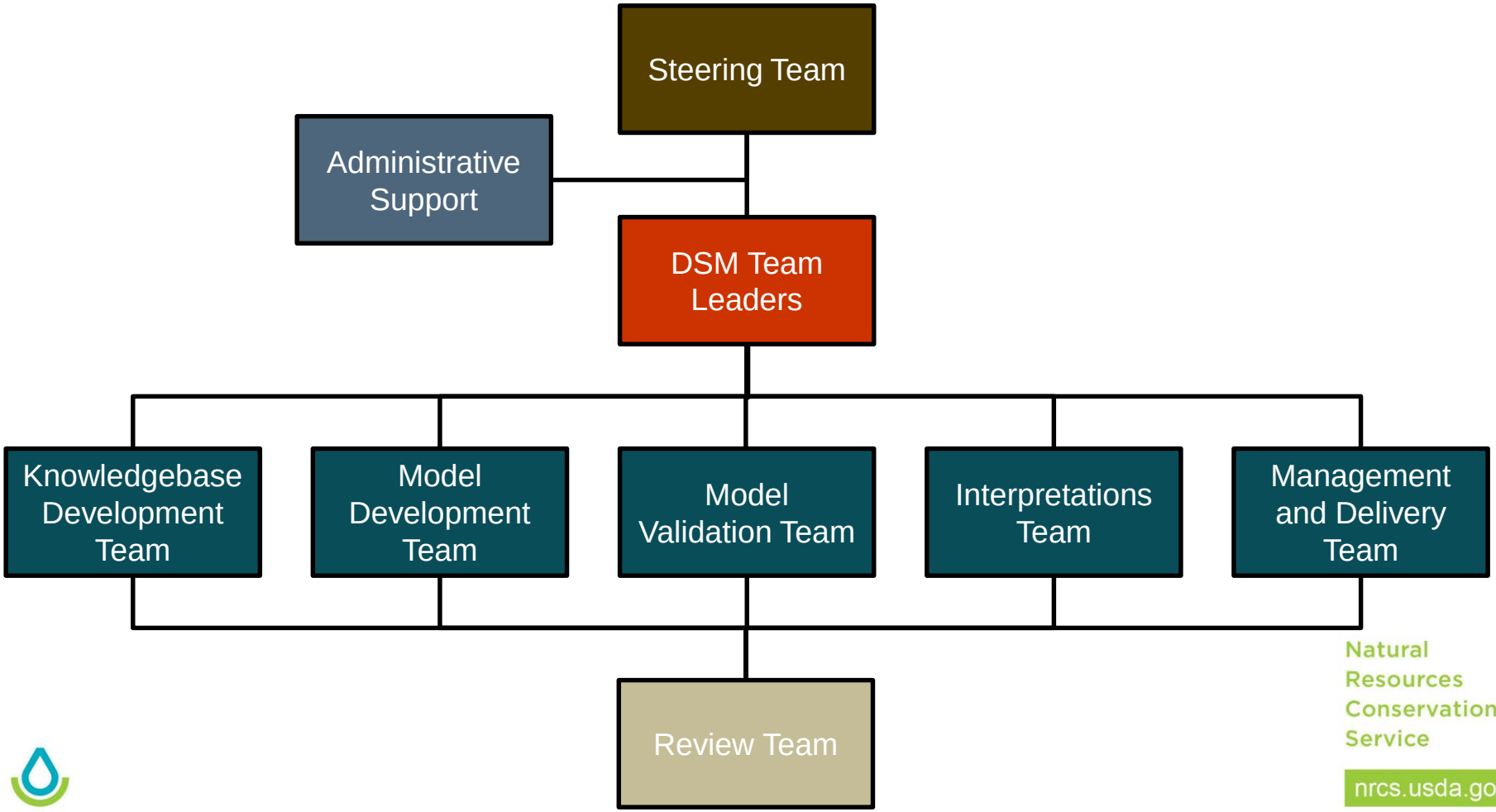
- **Approach**
  - Combine traditional field work with advanced technologies
  - Increase our understanding of soil-landform-plant community relationships
- **Develop national field weeks**
  - Critical and emerging issues
  - Innovative ideas
- **Training & Employee Development**

National Focus Teams

- Ecological Sites
- Urban Soils
- NASIS/Database
- Leadership/Recruitment
- Outreach
- Coastal Zone Mapping
- NCSS
- Initial Soil Mapping
- Digital Soil Mapping
- Training
- Taxonomy
- Research
- Soil Biology

Soils2026:
A ten-year plan

Obligatory Organizational Chart



Steering Team

SSD Director (David Lindbo, NRCS, WDC)
NSSC Director (David Hoover, NRCS, NSSC)
2 Regional Directors (Chad Remley - KS, Eva Muller - MT)
3 State Soil Scientists (Cory Owens - OR, Debbie Surabian - CT, Wade Bott - ND)
3 NCSS Cooperators (Larry Laing - USFS, Mickey Ransom - KSU, Joey Shaw - Auburn)
1 National Leader (Mike Robotham, NRCS, WDC)

Coastal Zone Mapping Team

Leads – Greg Taylor, NC; Rob Tunstead, NJ; Jim Turenne, RI

- **Coordinate CZM activities across division (Procedures, equipment, safety)**
- **Identify training needs**
- **Identify needs to update standards – propose solutions**
- **Identify needs to update taxonomy – propose solutions**
- **Assemble existing data**
- **Identify gaps**
- **Provide guidance on priority areas**

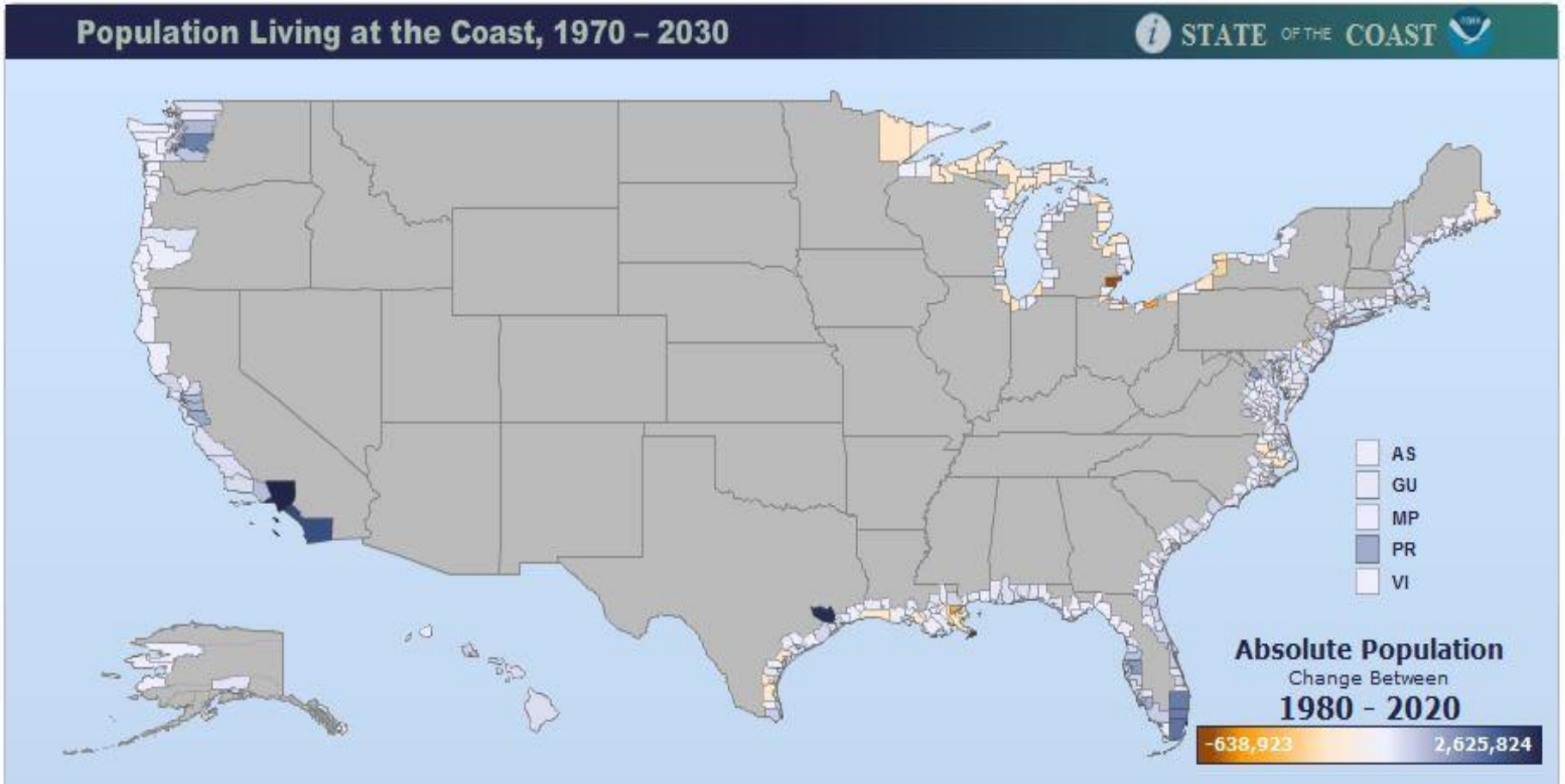
Coastal Zone Soil Survey – Why?

39%
Percent of the nation's total population that lived in Coastal Shoreline Counties in 2010 (less than 10% of the total land area excluding Alaska).
Source: U.S. Census Bureau, 2011

34.8 million
Increase in U.S. Coastal Shoreline County population from 1970 to 2010 (or a 39% increase).
Source: U.S. Census Bureau, 2011

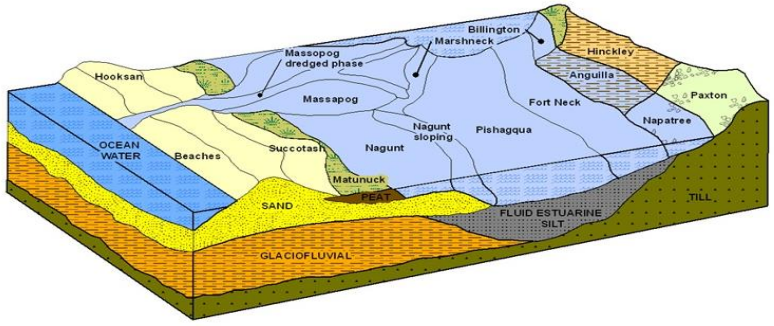
446 persons/mi²
Average population density of the Coastal Shoreline Counties (excluding Alaska). Density in U.S. as a whole averages 105 persons/mi².
Source: U.S. Census Bureau, 2011

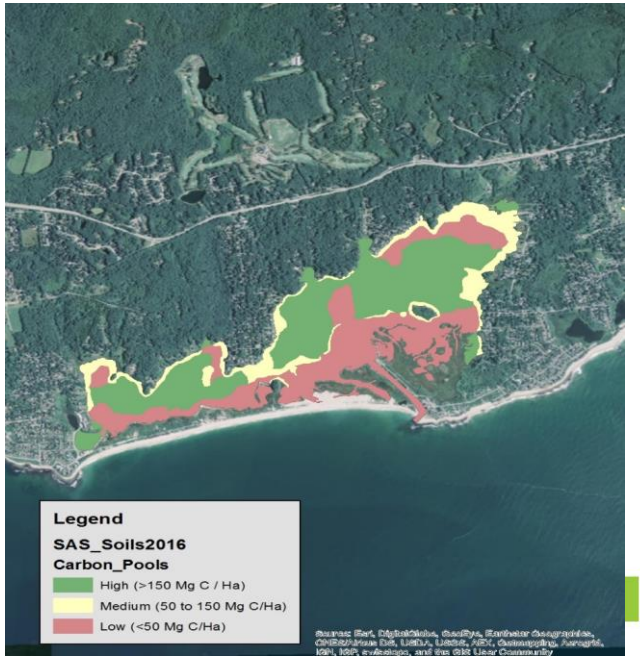
37 persons/mi²
Expected increase in U.S. Coastal Shoreline County population density from 2010–2020. Expected increase for entire U.S. is 11 persons/mi².
Source: Woods & Poole, 2011; NOAA, 2012



Coastal Zone Mapping Interpretations

- Eastern oyster and hard clam suitability and restoration potential
- Land utilization of dredged materials interpretation
- Salt marsh / thin layer placement potentials
- Eelgrass suitability potential and maps
- Mooring and deadweight interpretation
- Living Shoreline Project Interpretation
- Blue carbon pool maps





Initial Mapping Team

Lead – Mike Regan, OR

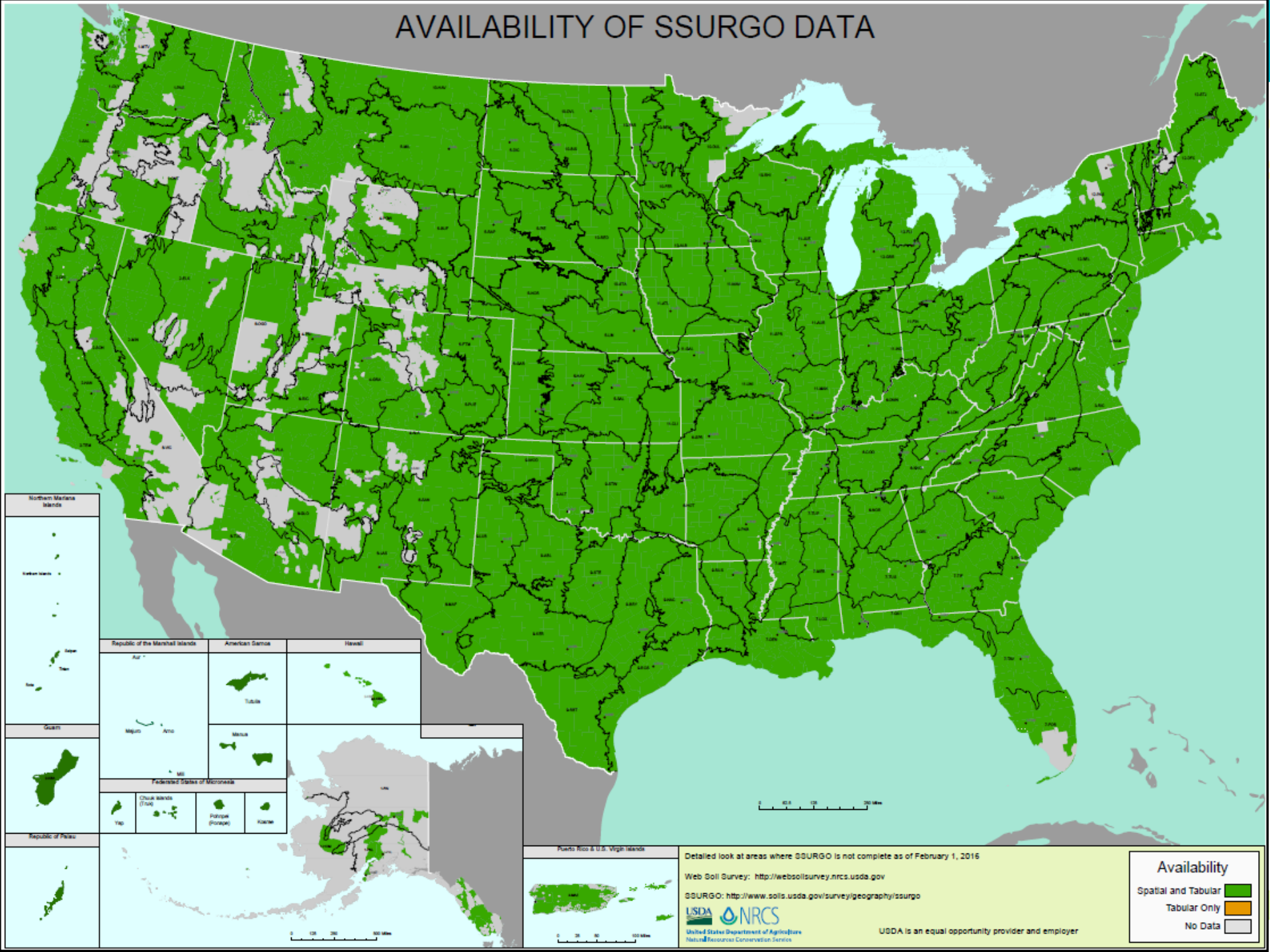
- Coordinate Initial activities across division and fed partners (Procedures, equipment, safety, standards)
- Develop, coordinate and implement the process to have full data coverage by FY2026
- Identify training needs
- Assist in development of new standards to facilitate full data coverage by FY2026
- Assemble existing data
- Identify gaps
- Provide guidance on priority areas

Digital Soil Mapping Team

Leaders – Michael Whited, MN; Tom D'Avello, WV; Suzann Kienast-Brown, MT; Dr. Jim Thompson, WVU

- Coordinate DSM activities across division (procedures, equipment)
- Identify training needs
- Identify needs to update standards – propose solutions
- Provide pilot project (Olympic Peninsula?) to demonstrate methods
- Provide annual field exercises
- Assemble existing data
- Identify gaps
- Provide guidance on priority areas

AVAILABILITY OF SSURGO DATA



Initial Mapping Status

Land Manager	Total Acres	Acres Mapped	Total Mapped
Native American Lands	108,998,542	63,354,237	58.1%
BLM – Bureau of Land Management	229,734,213	208,971,745	91.0%
FS – Forest Service	196,679,815	140,801,970	71.6%
NPS – National Park Service	76,001,507	66,260,860	87.2%
Other federal lands	114,408,729	102,218,367	89.3%
Non-federal lands	1,574,094,114	1,536,421,156	97.6%
TOTAL	2,337,215,506	2,153,074,971	92.1%

Initial Survey Considerations

Order 2 = 35,000 acres per FTE

Order 3 = 55,000 acres per FTE

Order 3+ = 100,000 acres per FTE (West region)

Considerations

Assume mapping rate is 100,000 ac/FTE

SSD has about 80 FTEs available for initial mapping;

80 FTEs can map 8 million acres/yr

184,140,535 acres remaining…

…23 years to complete the initial inventory

Considerations

Increase the number of FTEs

- Contracts with other agencies
- Re-allocate of current staff

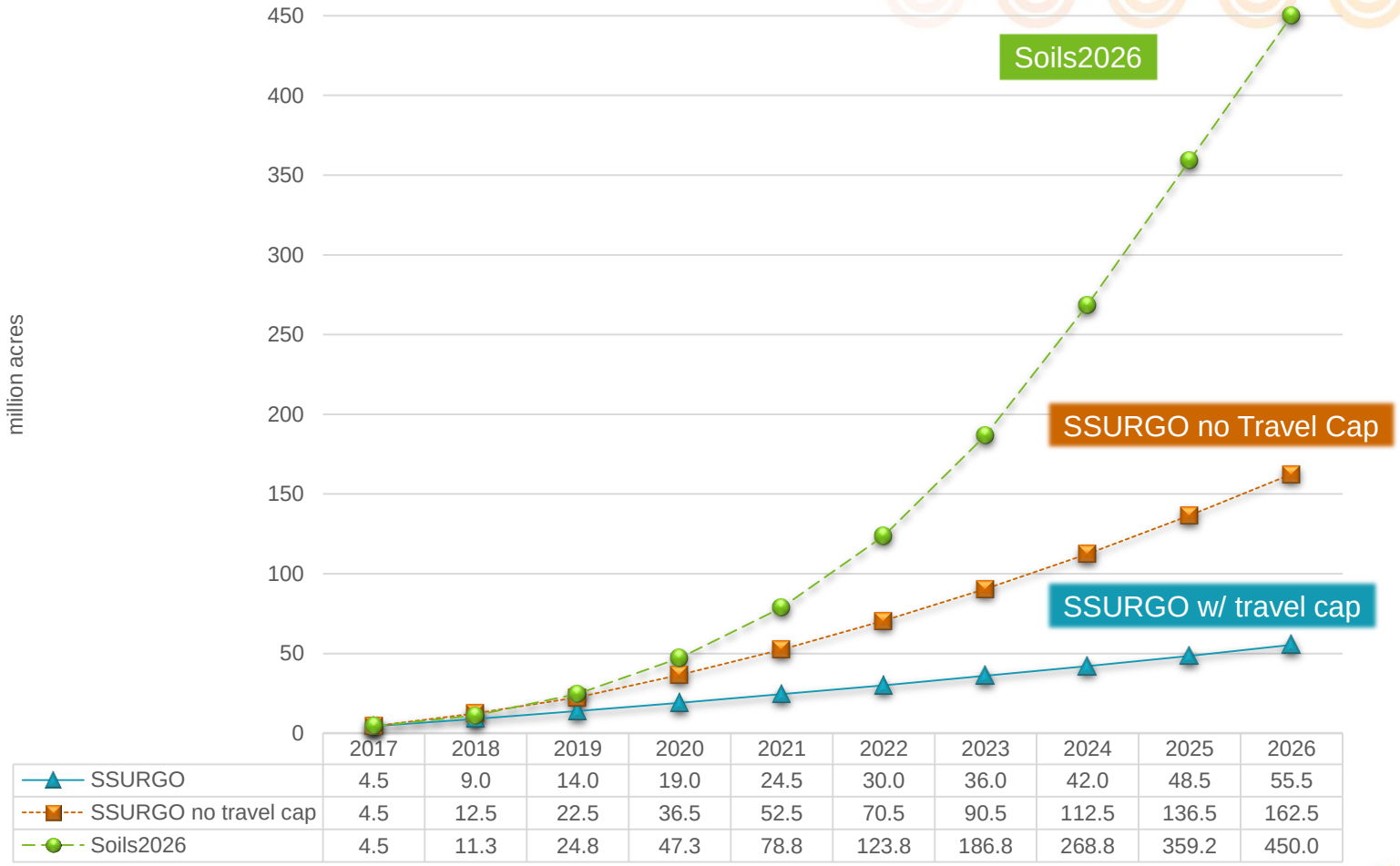
Increase mapping rates

- Quality may suffer

Solution:

- Use proven digital soil mapping techniques
- Develop new standards

Cumulative Initial Acres



	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
SSURGO	4.5	9.0	14.0	19.0	24.5	30.0	36.0	42.0	48.5	55.5
SSURGO no travel cap	4.5	12.5	22.5	36.5	52.5	70.5	90.5	112.5	136.5	162.5
Soils2026	4.5	11.3	24.8	47.3	78.8	123.8	186.8	268.8	359.2	450.0

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Ecological Site Team

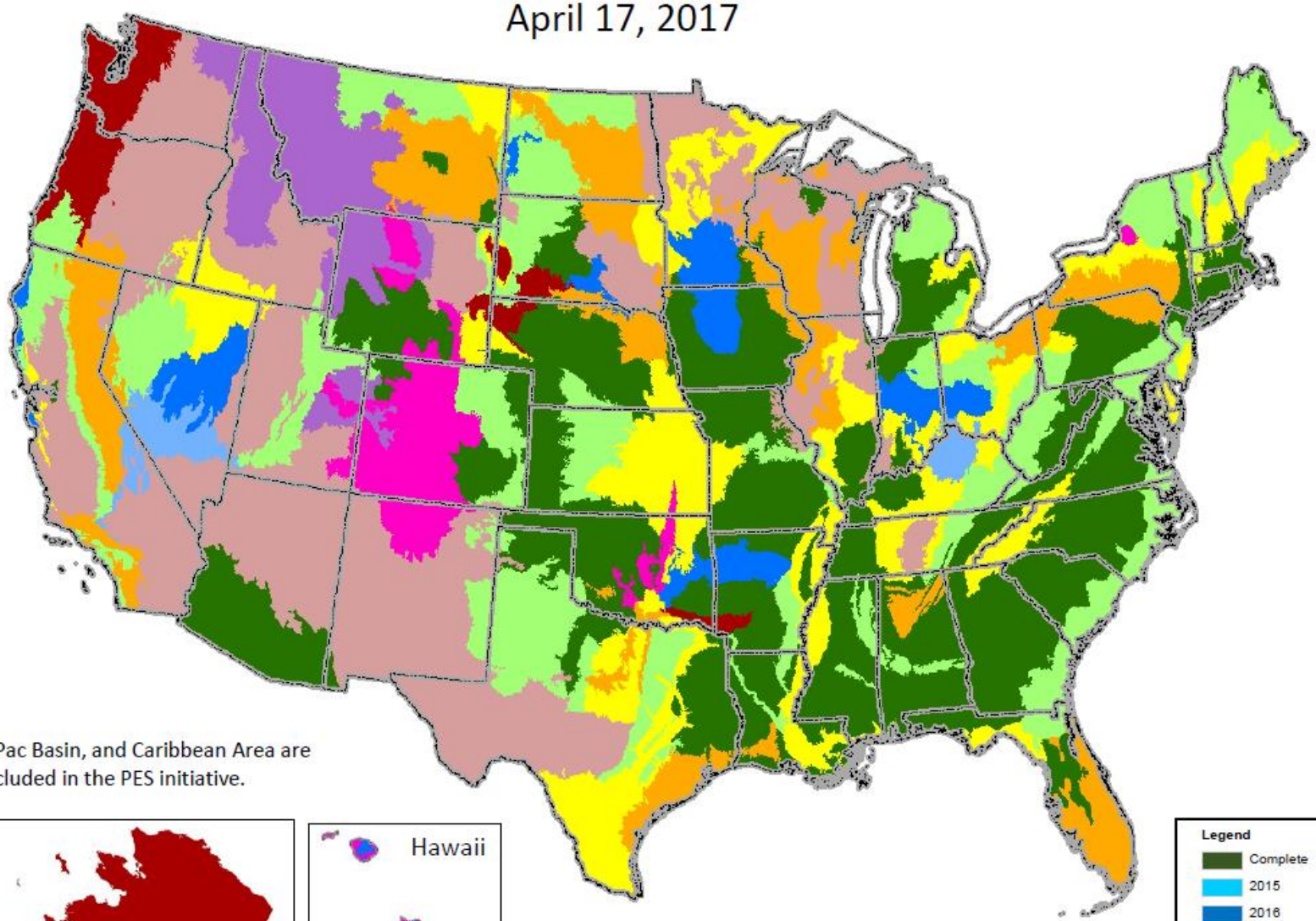
Leader – Joel Brown, NSSC (MN)

- Coordinate ESD/PESD activities across division and federal partners
- Identify training needs
- Identify needs to update standards – propose solutions
- Develop and test new ESD/PESD for all land uses
- Assemble existing data
- Identify gaps
- Provide guidance on priority areas

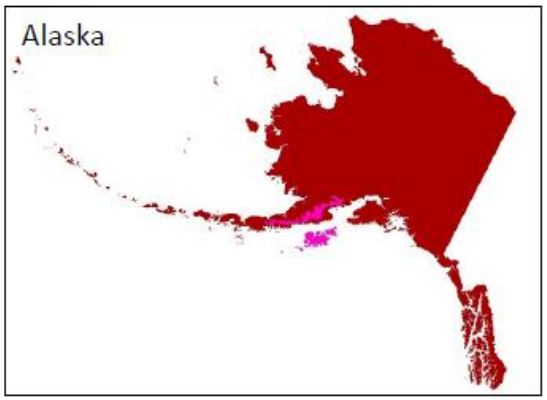
Provisional Ecological Site Initiative 2016-2020

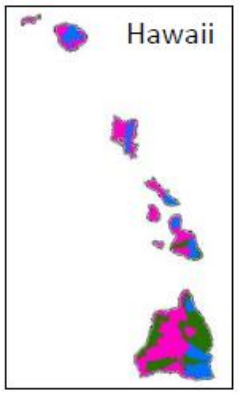
- Assign every soil map unit component in NASIS to a provisional ecological site group
- MLRA is the functional unit for correlation
- Develop generalized state and transition models of ecosystem response to management
- Reconcile existing ecological site groupings, state and transition models and interpretations
- Integrate conservation planning principles (practices) into state and transition models
- Prepare for explicit connections to a conservation planning platform (CDSI)

PES Status
April 17, 2017

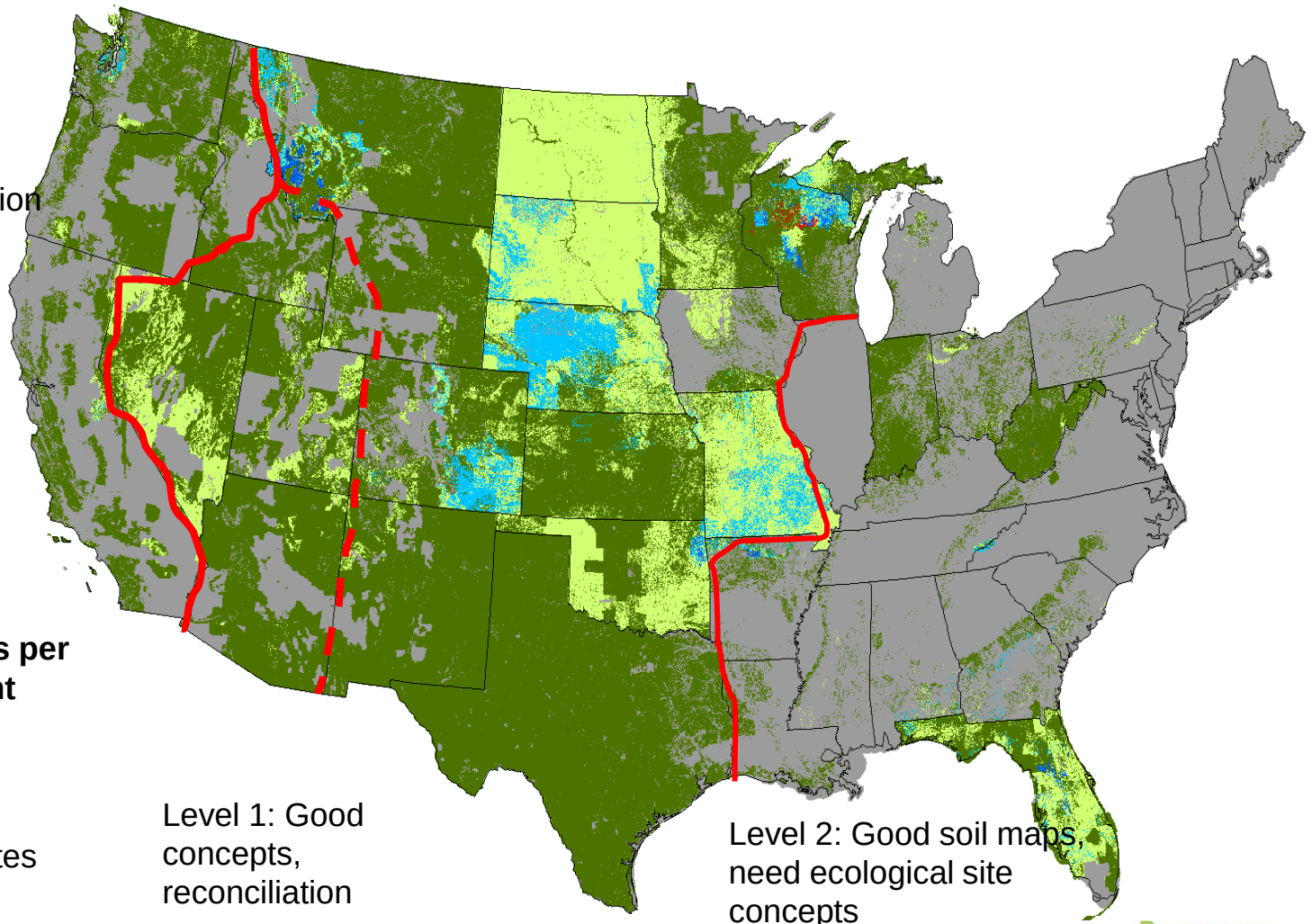


Note: AK, HI, Pac Basin, and Caribbean Area are not included in the PES initiative.



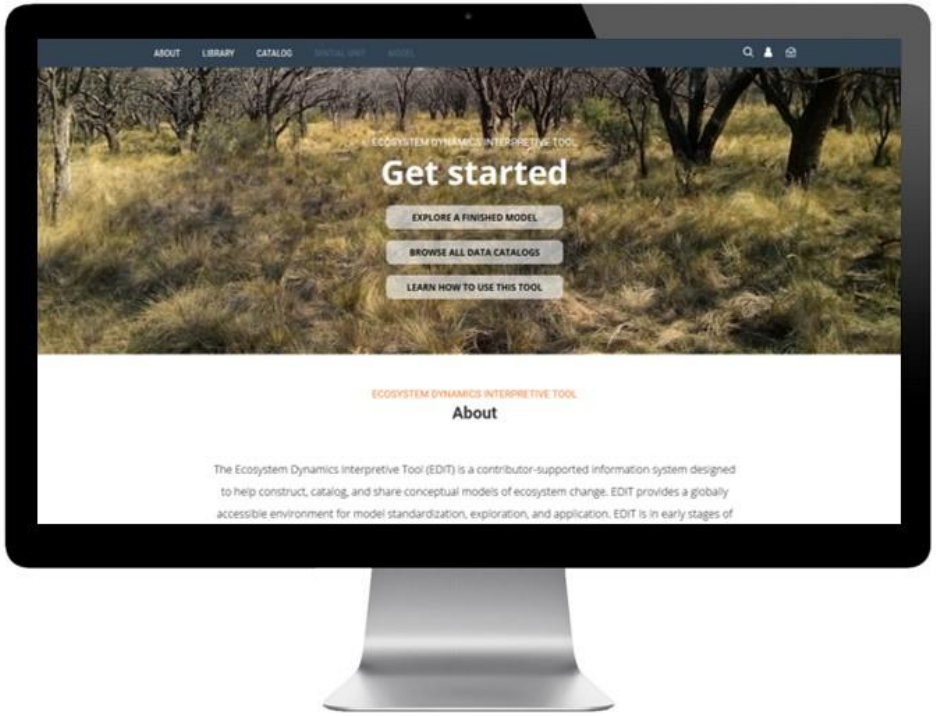


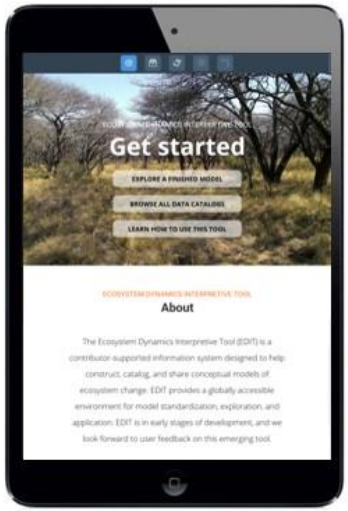
Level 2: Need soil and ecological site information



Construction and population of a new ecological site information database

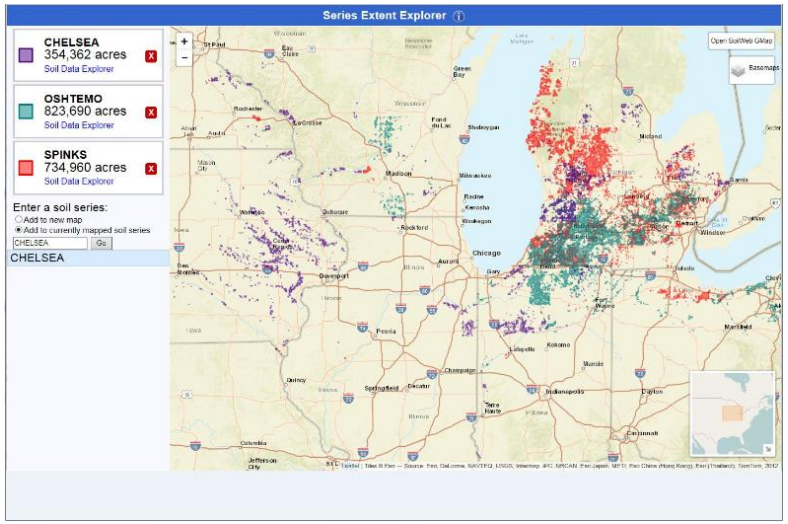
Ecosystem Dynamics Interpretive Tool (EDIT)

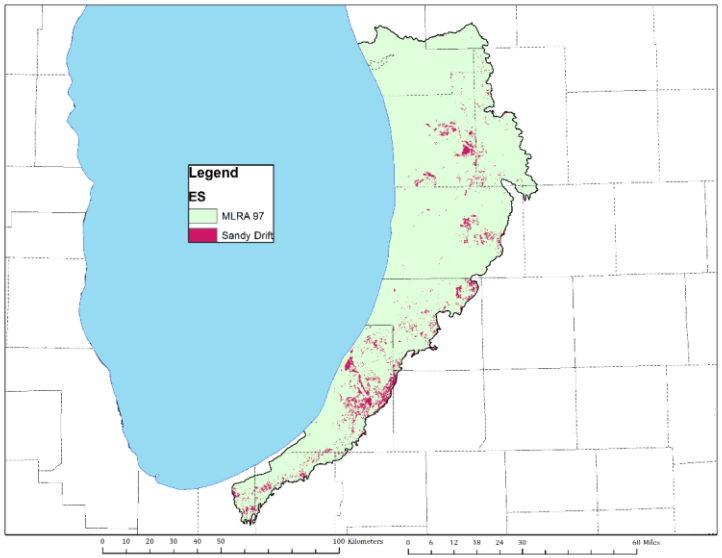




EXAMPLE: F097XA011MI - Sandy Drift Ecological Site

Extent





Concepts

Climate

Humid, warm continental climate

Geomorphology

Sandy Lake Plains

Edaphic

Sandy Soils more than 200 cm deep, pH > 5.5

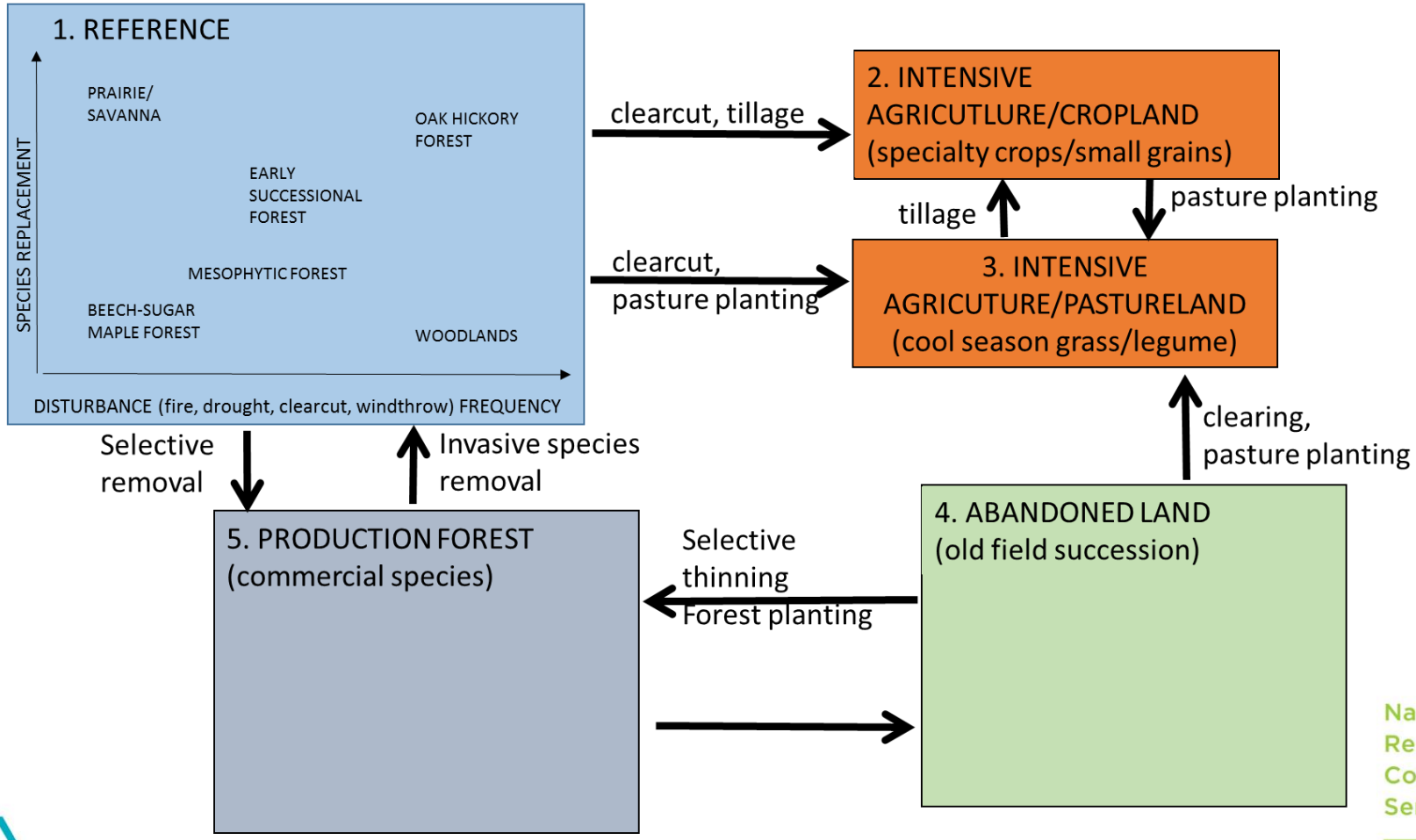
Hydrology

Water Table > 200 cm deep, Moderately to excessively well-drained, Outside the lake effect snow belt

Vegetation

Moderate nutrient requirements, Moderate drought tolerance, Frequent low-intensity fire regime, Frequent wind throw events

General state and transition model
F097XA011MI - Sandy Drift Ecological Site



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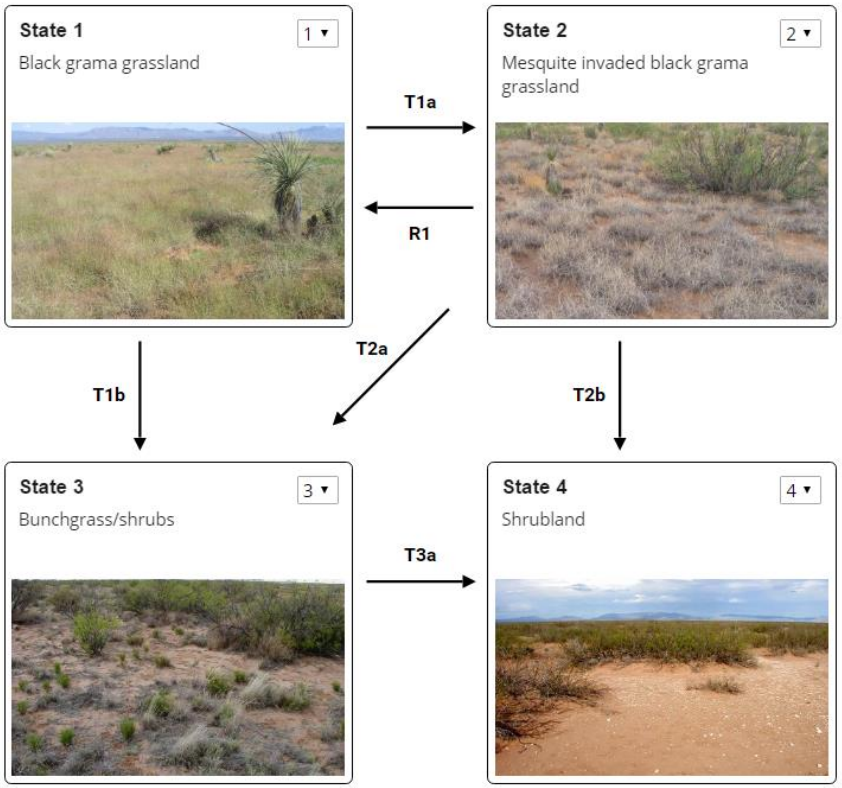
ABOUT LIBRARY CATALOG SPATIAL UNIT MODEL

Four-box Model | List Model | Circle-spoke Model | Keys



This model includes 5 states.

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sda.gov/

Moving Forward

- Deemphasize field work data collection
- Increase emphasis on synthesis and analytical skills
- Delivering information and knowledge about ecological sites to users
- Integration to the conservation planning and decision-making process via planning platform

Training Team

Leaders – Kevin Norwood, IN; Cynthia Stiles, CA

- Develop a training curriculum for all career trajectories within division
- Coordinate to extend to other entities (states, centers)
- Assist training coordinator in identify, selecting, and developing a training cadre
- Assist training coordinator in individual course development to fit within training curriculum
- Review existing courses
- Pursue the possibility of distance education for division staff to obtain advanced degrees
- Identify gaps
- Assist in development of web based courses

Training for GS-0470 Soil Scientist

GS-5,7

- Basic Soil Survey – Field and Lab (NRCS-NEDC-000012)
- Introduction to Digital Remote Sensing (NRCS-NEDC-000028)
- Soil Geomorphology Institute (NRCS-NEDC-000110)
- Remote Sensing for Soil Survey Applications (NRCS-NEDC-000244)
- Digital Soil Survey Data Editing (NRCS-NEDC-000250)
- Soil Survey Data Management (NRCS-NEDC-000251)
- Introduction to Image Interpretation (NRCS-NEDC-000275)
- NASIS Users Guide
- NASIS How-To Videos on YouTube
- Understanding Soil Interpretations

GS-9-11

- Statistics for Soil Survey
- Spatial Analysis Workshop
- Soil Geomorphology Institute
- Soil Correlation
- Soil Science Institute

GS-12

- Soil Science institute
- Management of Soil Survey by MLRA

Taxonomy Team

- **Lead – Curtis Monger, NRCS-SSD, NSSC**
- **Charge**
  - Coordinate taxonomy update with NCSS and SSSA Taskforce
  - Evaluate proposal quickly
  - Evaluate the overall goal of Soil Taxonomy
  - Proactively solicit input
  - Hold annual Taxonomy meetings or review – subject specific

A few considerations

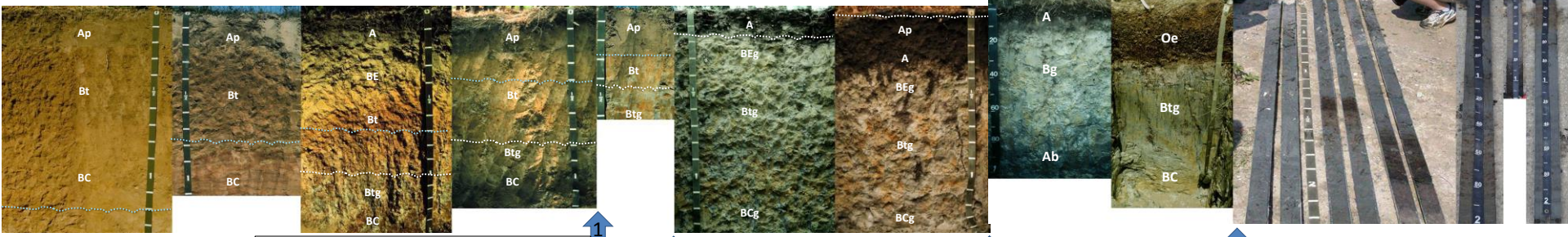
- A New Soil Order – Aquasols
- Moisture regimes at the Suborder level
- Revised definitions/criteria
  - Mollic Epipedon
  - Kandic Horizon
  - Aquic & Oxyaquic depth requirements

Aquasols???

Soil Wetness Continuum

Upland – Wetland Catena | Peraquic | Subaqueous

WD | MWD | MWD | SWPD | SWPD | PD | VPD



1

Boundary 1. Current Aqu suborders: Include very poorly, poorly, and at least some somewhat poorly drained soils
sustained aquic conditions within 40 cm of the soil surface
Considerations:
a. would include many soils across most orders, some of which are not especially wet (easily drained)
b. Guy Smith's argument regarding zonality of wet soils suggests keeping these within other orders

2

Boundary 2. Typic/not-Aeric portions of current Aqu suborders: exclude marginally wet soils (somewhat poorly drained)
sustained aquic conditions within some shallower depth - 25 cm of the soil surface? 10 cm of the surface?
Considerations:
a. takes only those soils that are wettest
b. Guy Smith's argument regarding zonality of wet soils may still argue for keeping these within other orders

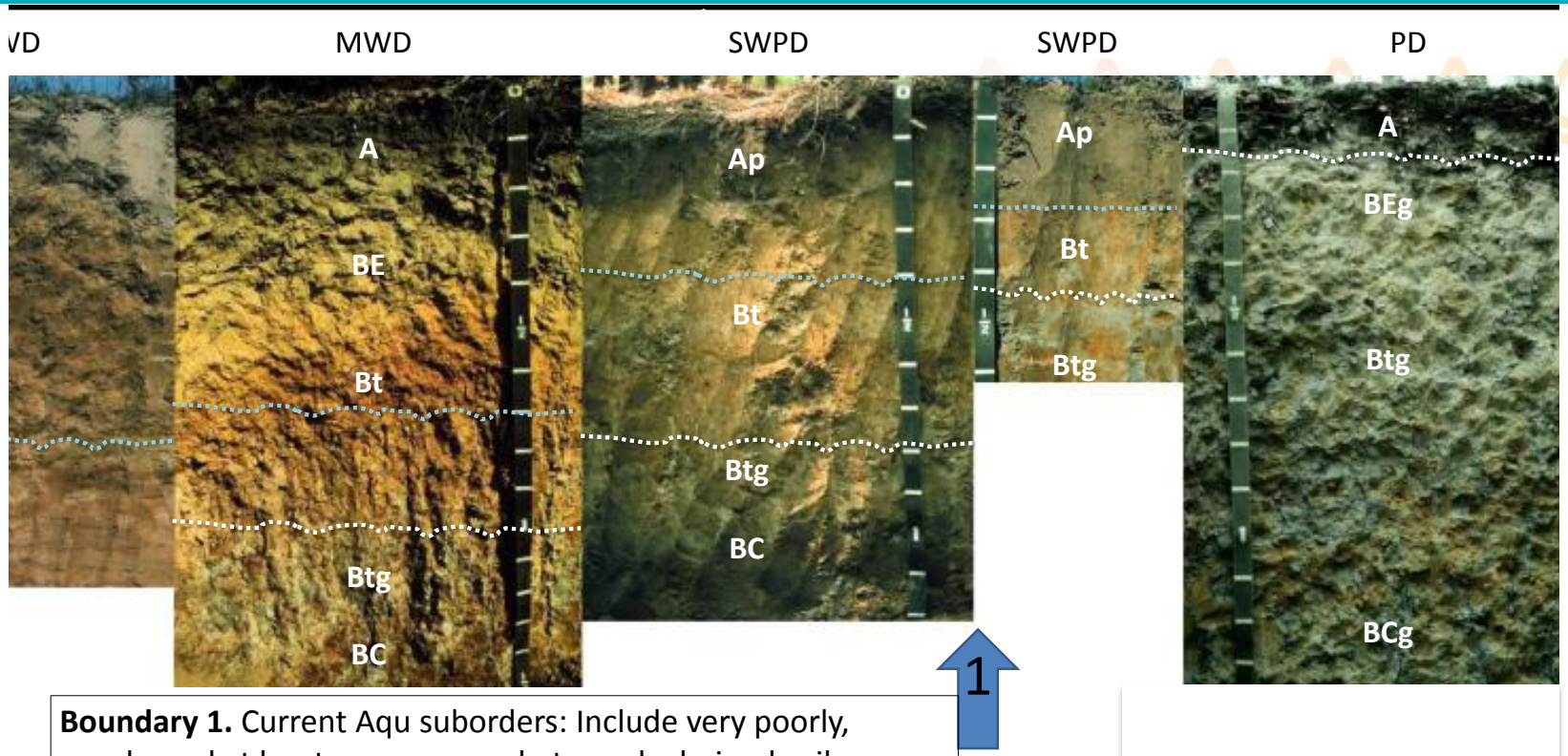
3

Boundary 3. Peraquic soils: essentially permanently wet, such as swamps, marshes, bogs, fens etc, supporting emergent vegetation
nearly continuous aquic conditions at or near the soil surface
Considerations:
a. This break includes only soils that have little potential for drainage or agriculture; the wettest of wet soils
b. This leaves many very wet soils outside of this class of wet soils

4

Boundary 4. Subaqueous soils: permanently flooded too deep to support emergent vegetation
use current definition for Wass suborders of Entisols
Considerations:
a. This break would separate only soils in subaqueous landscapes, a very narrow concept of the wettest soils.
b. It would be the easiest to implement and would have smallest impact on present *Soil Taxonomy*
c. A great many wet soils would not be included within this order of wet soils.

Boundary 1



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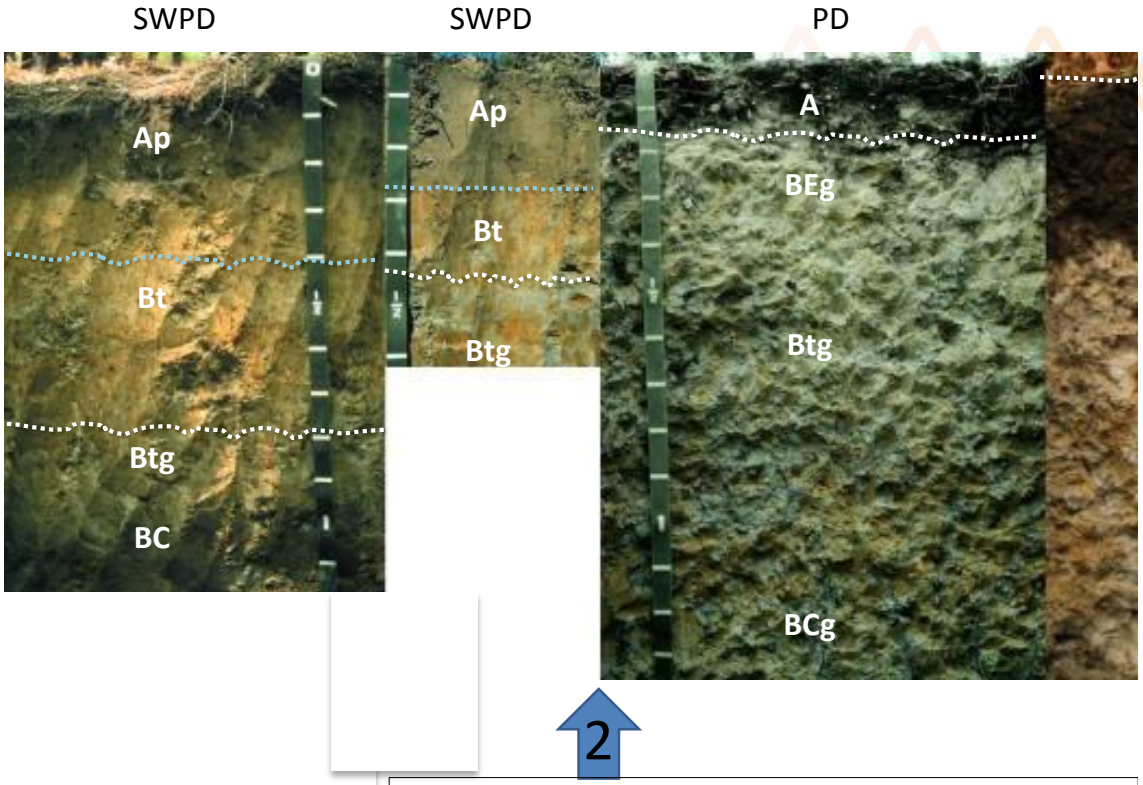
Boundary 2



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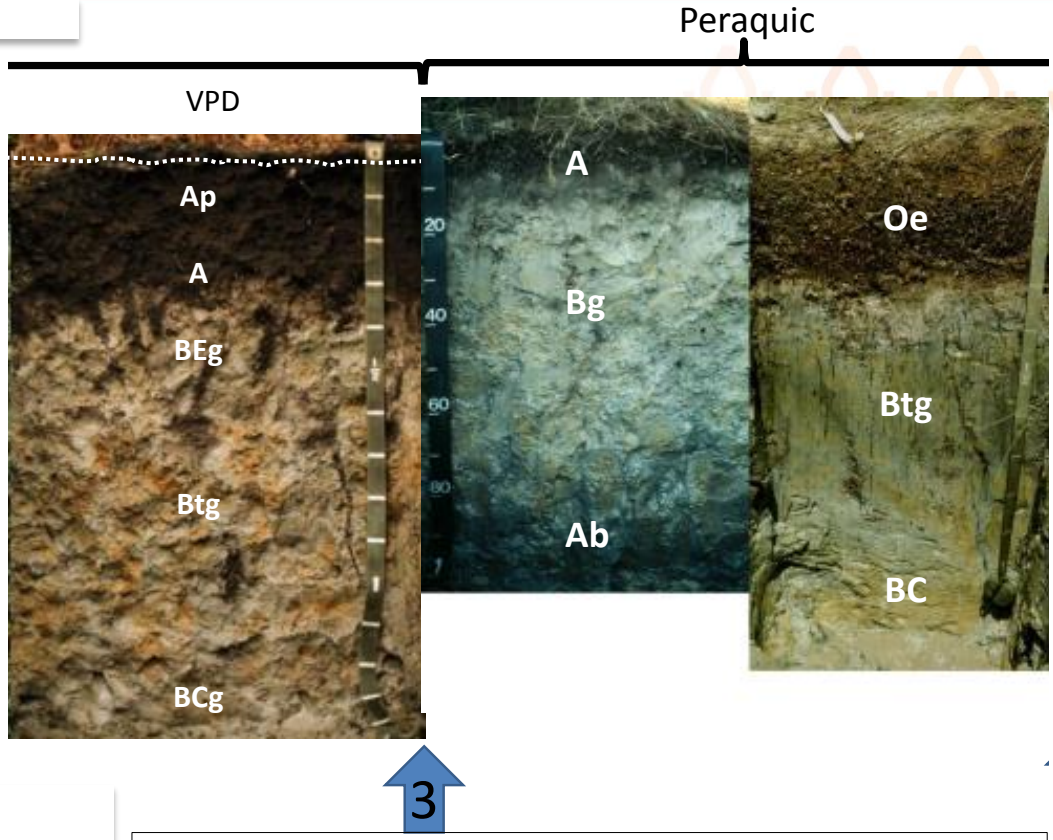
Boundary 3



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Boundary 4

Peraquic

Subaqueous

4

Boundary 4. Subaqueous soils: permanently flooded too deep to support emergent vegetation

use current definition for Wass suborders of Entisols

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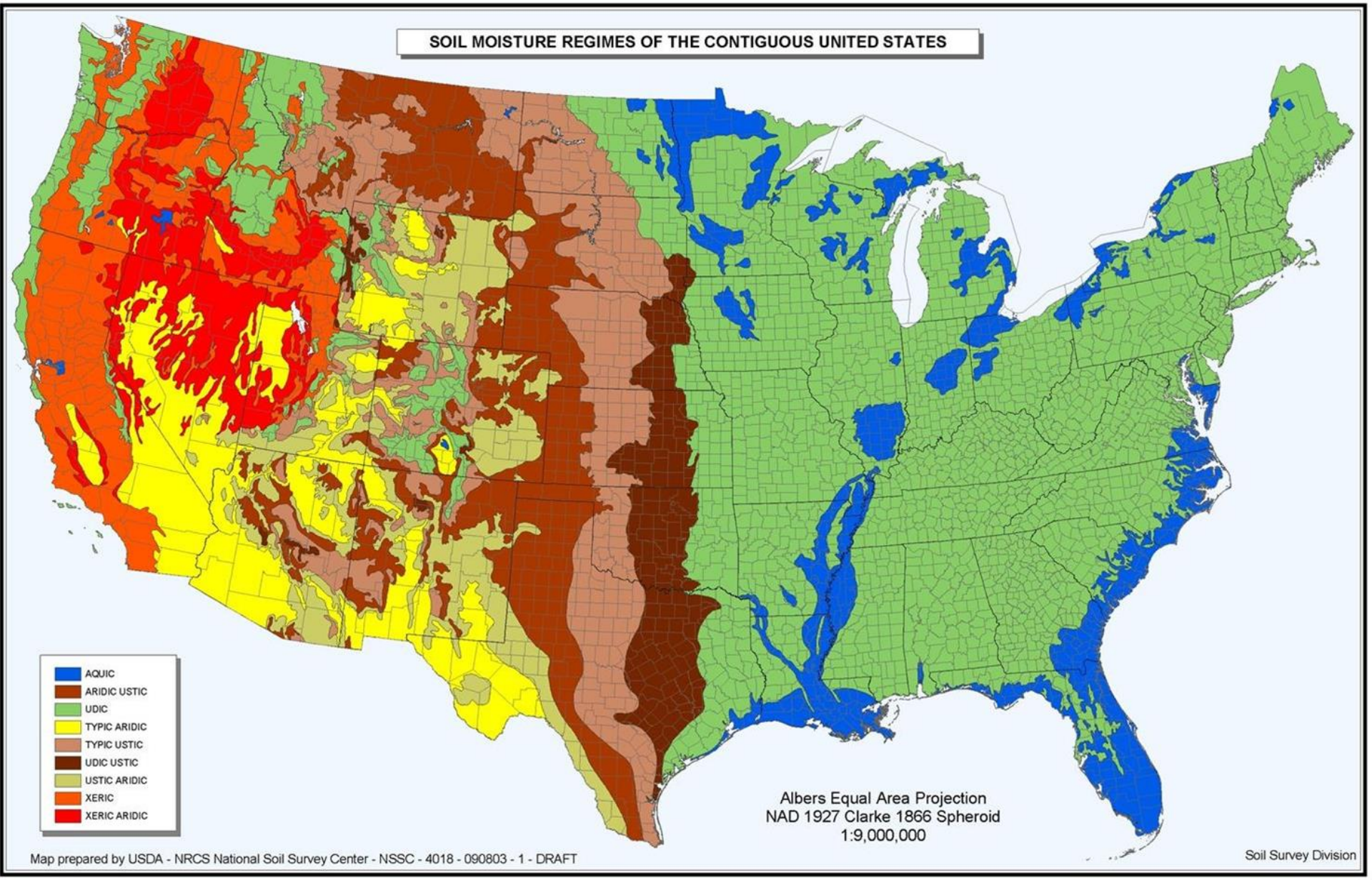
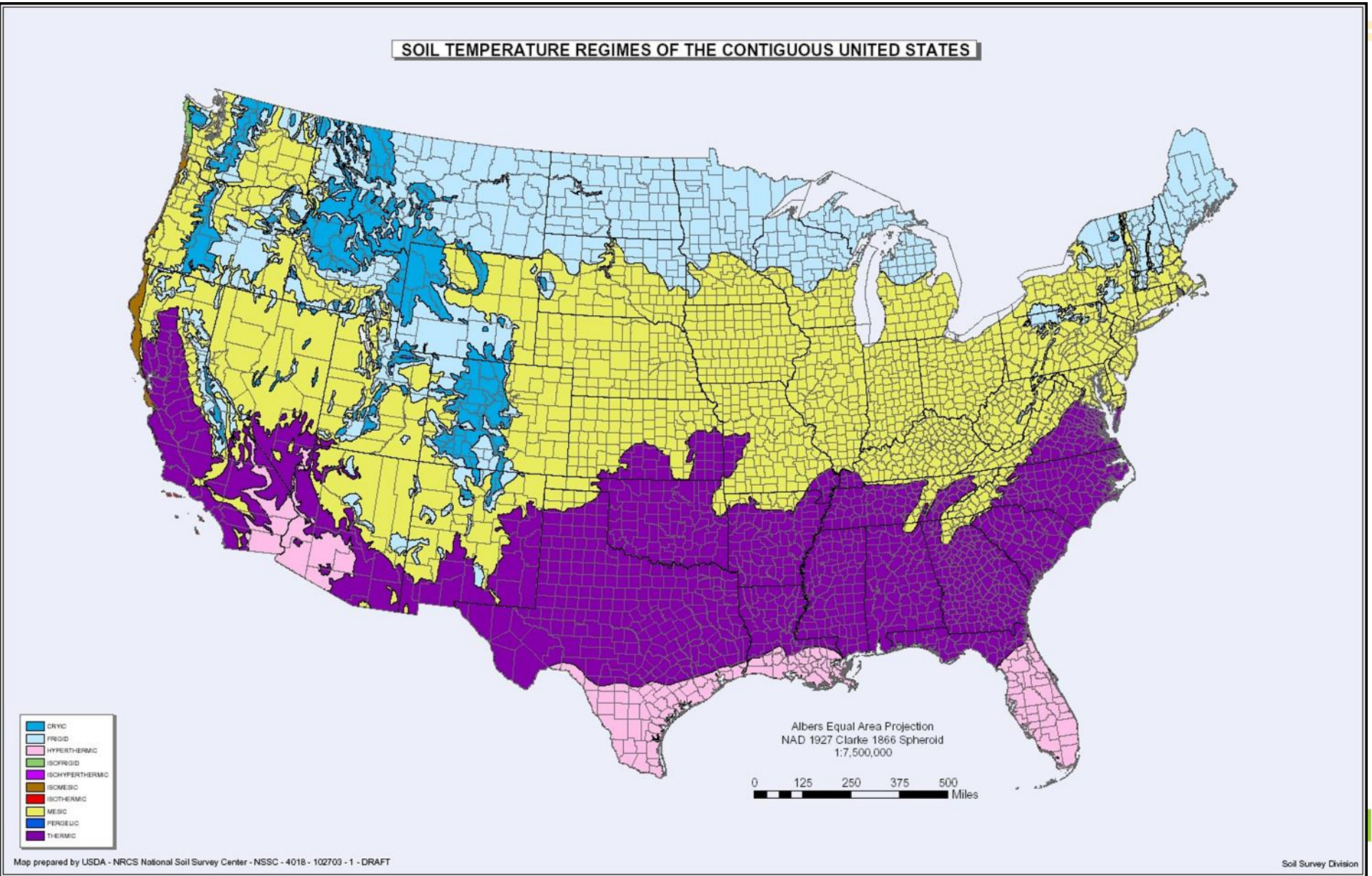
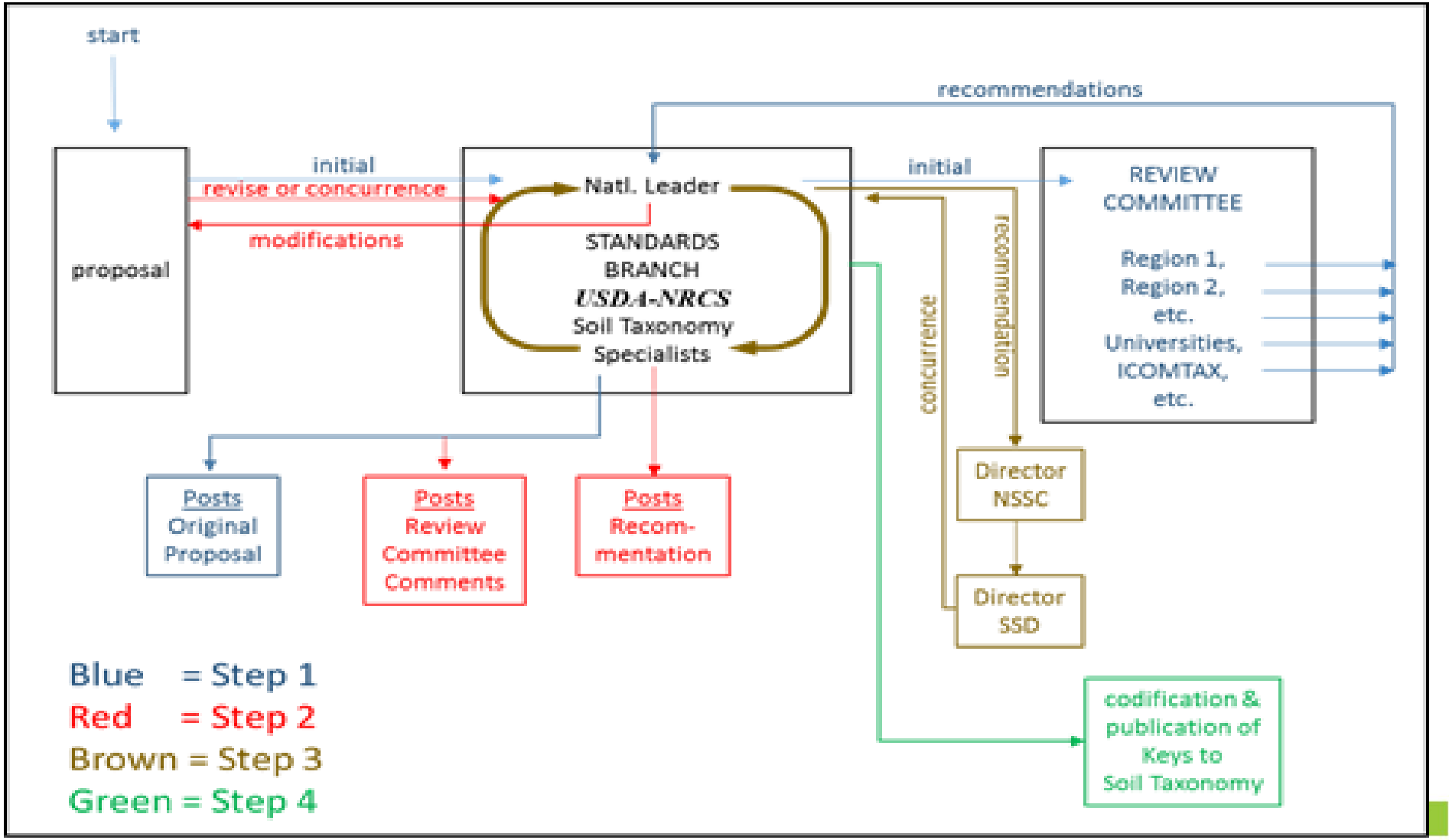
Moisture Regimes in Suborder?



Are Temperature Regimes in Suborder?



Taxonomy Review Process

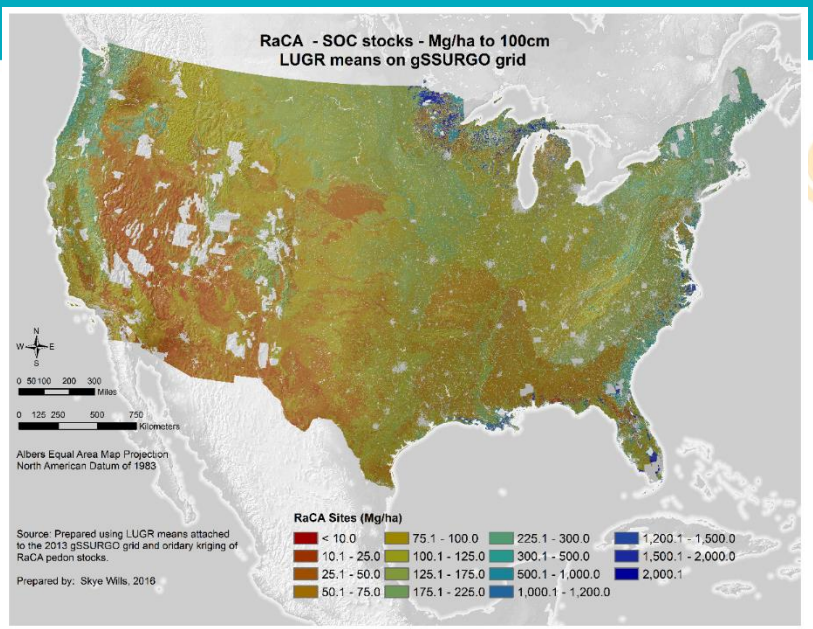


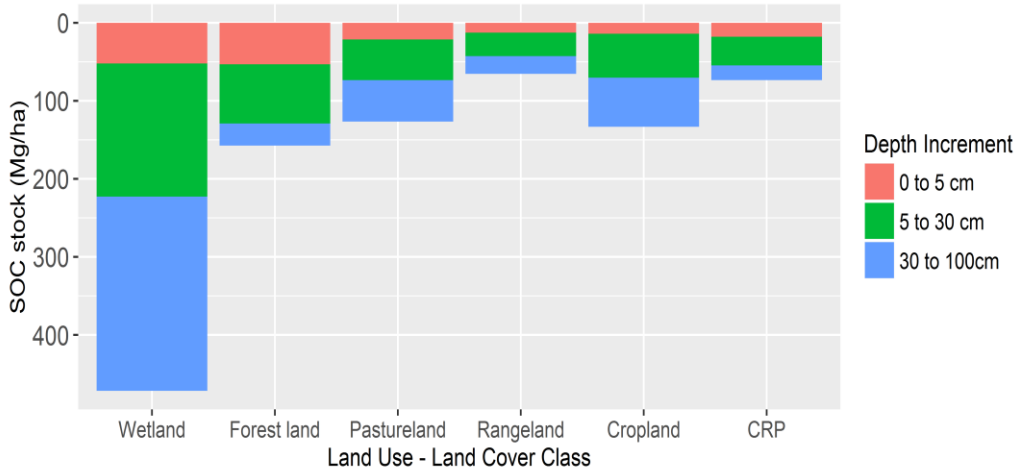
A few new developments from NSSC

- Revised RaCA report
- Soil Fragility Index
- MIR Project

Rapid Carbon Assessment (RaCA) update

- Statistically Valid Sampling
  - 6400 sites spread across regions, soils and land use/cover
- Initial VNIR estimates were inadequate
- KSSL analysis of soil carbon
- New summary and estimate available online
  - **https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/?cid=nrcs142p2_054164**
  - Entire process is made available as part of 'Open Science'
  - Specific locations are withheld





- Wide range in SOC concentrations and stocks
- Average SOC stock 73.5 Mg ha^{-1} to 1m (95% confidence interval 73 to 74)
- Near surface SOC is similar across land use/cover types
- At depth of 1m, wetland have much greater SOC stocks
- Wetlands have 30% of carbon stocks but are only 5% of area

Soil Fragility Index

Fragile soils are those that are most vulnerable to degradation

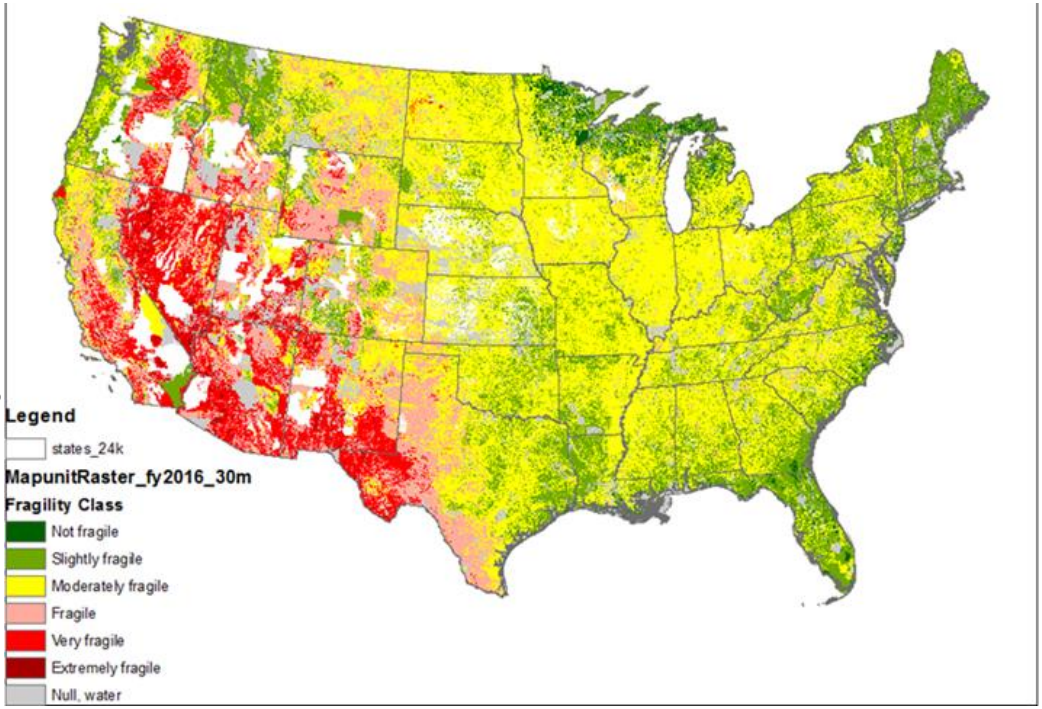
- easily degraded, low resistance
- high susceptibility to erosion with low resilience

Characteristics of fragile soils

- Low organic matter & stable aggregates
- On sloping ground
- In arid and semiarid regions
- Have sparse plant cover
- Have a shallow depth

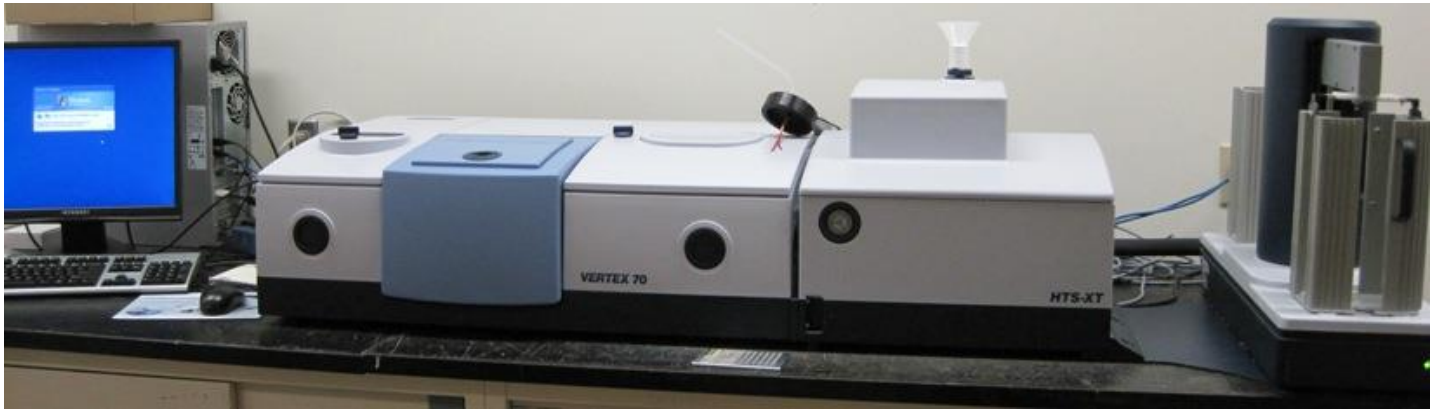
Classes of fragility

- not fragile, slightly fragile, moderately fragile, fragile, very fragile, extremely fragile



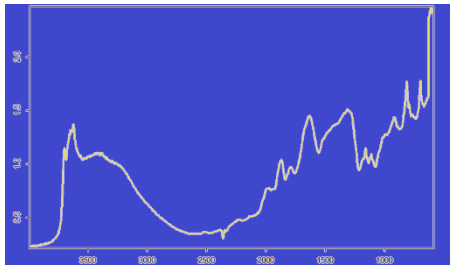
Fragile Soil Index can be used in conservation and watershed planning to assist in identifying soils and areas with greater vulnerability to degradation.

KSSL – Mid infrared (MIR) Spectrometry



One MIR Spectrum – Many Properties

Unknown Soil → MIR Scan



Total Carbon CEC Clay pH Carbonates, etc….

P R E D I C T I O N S

MIR Spectrometry offers rapid prediction of soil properties:

Potentially useful for field offices

- Minimal infrastructure required
- Reduced safety concerns

So, we are done?

"The times they are a changing"

Soil Health/Soil Biology

Soil Security

Urban Soils

Coastal and Subaqueous Soils

Terraforming????

"Selling" what we do – Public Relations

Embrace a Culture of Continuous Investigation and Improvement

"... I cannot conceive of the time when knowledge of soils will be complete. Our expectation is that our successors will build on what has been done, as we are building on the work of our predecessors." - *R.S. Smith, Director of the Illinois Soil Survey, 1928*

"... if this is to be a permanent nation we must save this most indispensable of all our God-given assets-the soil, from which comes our food and raiment. If we fail in this, remember that much sooner than we have expected this will be a nation of subsoil farmers." - *H.H. Bennett 1933*

Resource Needs

High priority positions

Agreements with partners

Supercomputer access

Additional IT, PR, and programming support

The will to do better

Freedom to be innovative

A Final Word

NCSS Conference, Boise, ID

June 25-29, 2017

Talk to me

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Questions?